

CLAIMS

What is claimed is:

- 5 1. A method for pacing a heart, comprising:
 providing a post ventricular atrial refractory period (PVARP) associated with
 a pacing timing sequence;
 delivering a bi-ventricular pacing therapy using the pacing timing sequence;
 detecting a disruption of ventricular pacing;
10 modifying the pacing timing sequence to restore ventricular pacing;
 delivering the bi-ventricular pacing therapy using the modified pacing timing
 sequence; and
 avoiding pacemaker mediated tachycardia during delivery of the bi-
 ventricular pacing therapy using the modified pacing timing sequence.
- 15 2. The method of claim 1, wherein detecting the disruption of ventricular
 pacing comprises detecting a premature ventricular contraction.
- 20 3. The method of claim 1, detecting the disruption of ventricular pacing
 comprises detecting a transient increase in heart rate above a maximum tracking
 rate.
- 25 4. The method of claim 1, wherein detecting the disruption of ventricular
 pacing comprises detecting one intrinsic atrial depolarization occurring within the
 PVARP.
5. The method of claim 1, wherein detecting the disruption of ventricular
 pacing comprises detecting an intrinsic ventricular depolarization.

6. The method of claim 1, wherein modifying the pacing timing sequence comprises adjusting the PVARP.

7. The method of claim 1, wherein modifying the pacing timing sequence comprises adjusting the PVARP for two or more successive cycles.

8. The method of claim 1, wherein modifying the pacing timing sequence comprises decreasing the PVARP.

10 9. The method of claim 1, wherein modifying the pacing timing sequence comprises ignoring the PVARP.

10. The method of claim 1, wherein delivering the bi-ventricular pacing therapy using the modified pacing timing sequence comprises avoiding pacemaker mediated tachycardia.

11. The method of claim 1, wherein delivering the bi-ventricular pacing therapy using the modified pacing timing sequence comprises restoring ventricular pacing following a premature ventricular contraction.

20 12. The method of claim 1, wherein delivering the bi-ventricular pacing therapy using the modified pacing timing sequence comprises restoring the ventricular pacing as an intrinsic atrial rate decreases below a maximum tracking rate.

25 13. The method of claim 1, wherein delivering the bi-ventricular pacing therapy using the modified pacing timing sequence comprises restoring ventricular pacing.

14. The method of claim 1, wherein delivering the bi-ventricular pacing therapy using the modified pacing timing sequence comprises avoiding pacing hysteresis as an intrinsic atrial rate decreases below a maximum tracking rate.

5 15. The method of claim 1, wherein delivering the bi-ventricular pacing therapy using the modified pacing timing sequence comprises pacing below an upper rate limit.

10 16. The method of claim 1, wherein delivering the bi-ventricular pacing therapy using the modified pacing timing sequence comprises implementing a ventricular tracking timing sequence.

15 17. The method of claim 1, further comprising interrupting the bi-ventricular pacing therapy using the modified pacing timing sequence if an intrinsic ventricular depolarization is detected.

18. The method of claim 1, wherein delivering the bi-ventricular therapy comprises:

20 selecting one or more ventricles selected from a left ventricle and a right ventricle; and
pacing the selected one or more ventricles.

19. The method or claim 1, wherein avoiding the pacemaker mediated tachycardia comprises:

25 detecting one or more pacemaker mediated tachycardia events; and
inhibiting atrial tracking based on the detection of the one or more pacemaker mediated tachycardia events.

20. The method or claim 1, wherein avoiding the pacemaker mediated tachycardia comprises:

detecting a retrograde p-wave; and
inhibiting initiation of a pacing escape interval based on the detection of the retrograde p-wave.

- 5 21. A cardiac rhythm management system, comprising:
 a lead system comprising electrodes for electrically coupling to a heart, the electrodes configured to deliver stimulation pulses to right and left ventricles of the heart and to sense electrical activity of the heart; and
 a pulse generator coupled to the lead system, the pulse generator
10 configured to implement a post ventricular atrial refractory period (PVARP) associated with a pacing timing sequence, deliver a bi-ventricular pacing therapy using the pacing timing sequence, detect a disruption of ventricular pacing, modify the pacing timing sequence to restore ventricular pacing, deliver a bi-ventricular pacing therapy using the modified pacing timing sequence, and avoid pacemaker
15 mediated tachycardia during delivery of the bi-ventricular pacing therapy using the modified pacing timing sequence.
22. The system of claim 21, wherein the disruption of ventricular pacing comprises one atrial event occurring within the PVARP.
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23. The system of claim 21, wherein the disruption of ventricular pacing comprises two or more atrial events occurring respectively within two or more successive PVARPs.
- 25 24. The system of claim 21, wherein the disruption of ventricular pacing comprises an intrinsic ventricular depolarization.
25. The system of claim 21, wherein the disruption of ventricular pacing comprises a premature ventricular contraction.
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26. The system of claim 21, wherein the pulse generator is configured to modify the pacing timing sequence by adjusting the PVARP.

27. The system of claim 21, wherein the pulse generator is configured to 5 modify the pacing timing sequence by decreasing the PVARP.

28. The system of claim 21, wherein the pulse generator is configured to modify the pacing timing sequence by ignoring the PVARP.

10 29. The system of claim 21, wherein the modified pacing timing sequence is configured to avoid pacing hysteresis as an intrinsic atrial rate decreases below a maximum tracking rate.

15 30. The system of claim 21, wherein the modified pacing timing sequence is configured to restore ventricular pacing following a premature ventricular contraction.

20 31. The system of claim 21, wherein the modified pacing timing sequence is configured to restore ventricular pacing following a transient increase in heart rate above a maximum tracking rate.

32. The system of claim 21, wherein the modified pacing timing sequence is configured to restore ventricular pacing as an intrinsic atrial rate decreases below a maximum tracking rate.

25 33. The system of claim 21, wherein the modified pacing timing sequence is configured to pace at a rate below an upper rate limit.

30 34. The system of claim 21, wherein the modified pacing timing sequence comprises a ventricular tracking pacing protocol.

35. The system of claim 21, wherein the modified pacing timing sequence is configured to avoid pacemaker mediated tachycardia.

- 5 36. A cardiac pacing system, comprising:
 means for providing a post ventricular atrial refractory period (PVARP) associated with a pacing timing sequence;
 means for delivering a bi-ventricular pacing therapy using the pacing timing sequence;
10 means for detecting a disruption of ventricular pacing;
 means for modifying the pacing timing sequence to restore ventricular pacing;
 means for delivering the bi-ventricular pacing therapy using the modified pacing timing sequence; and
15 means for avoiding pacemaker mediated tachycardia during delivery of the bi-ventricular pacing therapy using the modified pacing timing sequence.

37. The system of claim 36, further comprising means for detecting one atrial event occurring within the PVARP.

- 20 38. The system of claim 36, further comprising means for adjusting the PVARP.

- 25 39. The system of claim 36, further comprising means for adjusting the PVARP for two or more successive beats.

40. The system of claim 36, further comprising means for decreasing the PVARP.

41. The system of claim 36, further comprising:
means for selecting one or more ventricles from a right ventricle and a left ventricle; and
5 means for pacing the selected one or more ventricles.

42. The system of claim 36, further comprising means for pacing a left ventricle and a right ventricle.

10 43. The system of claim 36, further comprising means for interrupting the modified pacing sequence if an intrinsic ventricular depolarization is detected during implementation of the modified pacing timing sequence.

15 44. A method for pacing a heart, comprising:
delivering a bi-ventricular pacing therapy using a first pacing timing sequence associated with a post ventricular atrial refractory period (PVARP);
detecting a cardiac event that disrupts consistent ventricular pacing;
adjusting the PVARP;
delivering a modified bi-ventricular pacing therapy using the adjusted
20 PVARP; and
avoiding pacemaker mediated tachycardia during delivery of the modified bi-ventricular pacing therapy.